

REMARKS

Applicant respectfully requests consideration of this amendment submitted with the accompanying request for continued examination (RCE).

Applicant respectfully requests reconsideration of the rejection in the instant application.

Claims 1, 13, 20, 21, 22, 25, and 26 have been amended and claims 29-31 have been newly added. Upon entry of the above amendment, claims 1, 3, 5-19, and 21-31 remain pending in the present application.

Claim 1

Claim 1 presently stands rejected under 35 U.S.C. §103 as allegedly being unpatentable over SEL in view of Pryor, Versteeg, and Robson. Claim 1, as amended, reads as follows:

1. A method of forming diamond crystals or a diamond film comprising:
disposing a substrate in a reaction chamber;
introducing, in the absence of a gas stream, a liquid precursor substantially free of water and containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
vaporizing the liquid precursor; and
subjecting the vaporized precursor, in the absence of a carrier gas, to a plasma under conditions effective to disassociate the vaporized precursor and promote diamond growth on the substrate *in a pressure range from about 20 to 80 Torr.*

(Emphasis added). Applicant submits that the rejection of claim 1 under 35 U.S.C. §103 should be withdrawn because SEL in view of Pryor, Versteeg, and Robson, individually or in combination, do not disclose, teach, or suggest at least the feature of promoting diamond growth “in a pressure range from about 20 to 80 Torr” as highlighted in amended claim 1 above. In particular, SEL states that their system operates at less than 1 Torr (¶[11]). Additionally, Pryor, Versteeg, and Robson do not cure this deficiency of SEL as none of these references teach or

suggest the claimed pressure range. Thus, SEL in view of Pryor, Versteeg, and Robson do not disclose, teach, or suggest, at least the limitation highlighted above in amended claim 1, and therefore, the rejection to claim 1 should be withdrawn.

Claims 3, 5-12, and 19

Applicant respectfully submits that pending dependent claims 3, 5-12, and 19 include every feature of independent claim 1 and that SEL in view of Pryor, Versteeg, and Robson, individually or in combination, fail to disclose, teach, or suggest at least the features of claim 1 highlighted hereinabove. In addition, Applicant respectfully submits that pending claim 8 includes every feature of independent claim 1 and that SEL in view of Pryor, Versteeg, Robson, and Glesener, individually or in combination, fail to disclose, teach, or suggest at least the feature of claim 1 highlighted hereinabove. Thus, pending dependent claims 3, 5-12, and 19 are allowable over the prior art of record. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Claim 13

Claim 13 presently stands rejected under 35 U.S.C. §103 as allegedly being unpatentable over SEL in view of Pryor, Versteeg, and Robson. Claim 13, as amended, reads as follows:

13. A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:

- providing an apparatus including an inlet, a disassociation zone, a deposition zone and an outlet;
- introducing, in the absence of a gas stream, a liquid precursor substantially free of water and comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the inlet under conditions effective to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;
- disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and
- producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas and *in a pressure range from about 20 to 80 Torr.*

(Emphasis added). Applicant submits that the rejection of claim 13 under 35 U.S.C. §103 should be withdrawn because SEL in view of Pryor, Versteeg, and Robson, individually or in combination, do not disclose, teach, or suggest at least the feature of promoting diamond growth “in a pressure range from about 20 to 80 Torr” as highlighted in amended claim 13 above. In particular, SEL states that their system operates at less than 1 Torr (¶[11]). Additionally, Pryor, Versteeg, and Robson do not cure this deficiency of SEL as none of these references teach or suggest the claimed pressure range. Thus, SEL in view of Pryor, Versteeg, and Robson do not disclose, teach, or suggest, at least the limitation highlighted above in amended claim 13, and therefore, the rejection to claim 13 should be withdrawn.

Claims 14-18

Applicant respectfully submits that pending dependent claims 14-18 include every feature of independent claim 13 and that SEL in view of Pryor, Versteeg, and Robson, individually or in combination fail to disclose, teach, or suggest at least the features of claim 13 highlighted

hereinabove. Thus, pending dependent claims 14-18 are allowable over the prior art of record.

In re Fine, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Claim 21

Claim 21 presently stands rejected under 35 U.S.C. §103 as allegedly being unpatentable over SEL in view of Pryor, Versteeg, and Robson. Claim 21, as amended, reads as follows:

21. A method of forming diamond crystals or a diamond film comprising:
 - disposing a substrate in a reaction chamber ***in a non-magnetic microwave field plasma system;***
 - introducing a liquid precursor containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
 - vaporizing the liquid precursor;
 - subjecting the vaporized precursor to a plasma under conditions effective to disassociate the vaporized precursor; and
 - promoting diamond growth on the substrate, in the absence of a carrier gas, ***at a pressure in the range from about 20 to 80 Torr.***

(Emphasis added). Applicant submits that the rejection of claim 21 under 35 U.S.C. §103 should be withdrawn because SEL in view of Pryor, Versteeg, and Robson, individually or in combination, do not disclose, teach, or suggest promoting diamond growth “in a pressure range from about 20 to 80 Torr” as highlighted in amended claim 21 above. In particular, SEL states that their system operates at less than 1 Torr (¶[11]).

In addition, SEL attempted to produce diamond without use of the magnetic field, which resulted in an “amorphous-like carbon film [that] is remarkable” (¶[22]). SEL indicates that the material produced without using a magnetic field was unlike the diamond film produced using a strong magnetic field microwave plasma CVD system (¶[19]), as evidenced by a minor peak amidst a much larger carbon peak in the spectrum. In addition, the non-magnetic deposition process produced, at best, a low quality non-uniform diamond film (*i.e.*, dispersion thickness of

about 50% (¶[21])). This should be compared to FIGS. 3, 5, 7, 11, and 15 of the Applicant's disclosure, which shows strong peaks illustrative of the formation of diamond. Further, Applicant's claimed method produces high quality diamond films in contrast to that shown in SEL. Thus, SEL in view of Pryor, Versteeg, and Robson do not disclose, teach, or suggest, at least the features highlighted above in amended claim 21, and therefore, the rejection to claim 21 should be withdrawn.

Claims 22-24 and 29

Applicant respectfully submits that pending dependent claims 22-24 and 29 include every feature of independent claim 21 and that SEL in view of Pryor, Versteeg, and Robson, individually or in combination, fail to disclose, teach, or suggest at least the features of claim 21 highlighted hereinabove. Thus, pending dependent claims 22-24 and 29 are allowable over the prior art of record. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Claim 25

Claim 25 presently stands rejected under 35 U.S.C. §103 as allegedly being unpatentable over SEL in view of Pryor, Versteeg, and Robson. Claim 25, as amended, reads as follows:

25. A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:

providing *a non-magnetic microwave field plasma apparatus* including an inlet, a disassociation zone, a deposition zone and an outlet;

introducing a liquid precursor comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the inlet under conditions effective to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;

disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and

producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas at *a pressure in the range from about 20 to 80 Torr.*

(Emphasis added). Applicant submits that the rejection of claim 25 under 35 U.S.C. §103 should be withdrawn because SEL in view of Pryor, Versteeg, and Robson, individually or in combination, do not disclose, teach, or suggest promoting diamond growth “in a pressure range from about 20 to 80 Torr” as highlighted in amended claim 25 above. In particular, SEL states that their system operates at less than 1 Torr (¶[11]).

In addition, SEL attempts to produce diamond without use of the magnetic field, which resulted in an “amorphous-like carbon film [that] is remarkable” (¶[22]). SEL indicates that the material produced without using a magnetic field was unlike the diamond film produced using a strong magnetic field microwave plasma CVD system (¶[19]), as evidenced by a minor peak amidst a much larger carbon peak in the spectrum. In addition, the non-magnetic deposition process produced, at best, a low quality non-uniform diamond film (*i.e.*, dispersion thickness of about 50% (¶[21])). This should be compared to FIGS. 3, 5, 7, 11, and 15 of the Applicant’s disclosure, which show strong peaks illustrative of the formation of diamond. Further, Applicant’s claimed invention produces high quality diamond films in contrast to that shown in SEL. Thus, SEL in view of Pryor, Versteeg, and Robson do not disclose, teach, or suggest, at

least the limitations highlighted above in amended claim 25, and therefore, the rejection to claim 25 should be withdrawn.

Claims 26-28 and 30

Applicant respectfully submits that pending dependent claims 26-28 and 30 include every feature of independent claim 25 and that SEL in view of Pryor, Versteeg, and Robson, individually or in combination fail to disclose, teach, or suggest at least the features of claim 25 highlighted hereinabove. Thus, pending dependent claims 26-28 and 30 are allowable over the prior art of record. *In re Fine*, 5 U.S.P.Q.2d 1596, 1600 (Fed. Cir. 1988).

Claim 31

Newly added claim 31 reads as follows:

31. A method of forming diamond crystals or a diamond film comprising:
disposing a substrate in a reaction chamber in ***a non-magnetic microwave field plasma system;***
introducing a liquid precursor containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
vaporizing the liquid precursor;
subjecting the vaporized precursor to a plasma under conditions effective to disassociate the vaporized precursor, wherein ***the conditions in the non-magnetic field plasma system include having a microwave power in the range from about 0.9 kW to 2kW and a substrate temperature in the range between about 750 °C and 1030 °C;*** and
promoting diamond growth on the substrate at a rate between about 1 and 2.7 micrometers per hour in a pressure range from about 20 to 80 Torr.

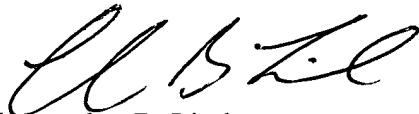
(Emphasis added). Applicant submits that SEL, Pryor, Versteeg, and Robson, individually or in combination, do not disclose, teach, or suggest the claim 31. In particular, Applicant submits that the cited references do not disclose, teach, or suggest the highlighted portions of claims 31

above. In this regard, the cited references do not disclose, teach, or suggest promoting diamond growth at the rate of 1 to 2.7 micrometers per hour in a non-magnetic microwave field plasma system under the conditions highlighted above. Thus, claim 31 should be in condition for allowance.

CONCLUSION

It is respectfully submitted that claims 1, 3, 5-19, and 21-31 of the present application are in a condition for allowance and an early notice to such effect is earnestly solicited. If the Examiner believes that unresolved issues remain, it is requested that the Examiner contact the undersigned counsel for Applicant by telephone in order to expedite resolution and disposal of the issues.

Respectfully submitted,



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ANNOTATED VERSION OF MODIFIED CLAIMS TO SHOW CHANGES MADE

The following is a marked up version of the amended claims. Amend the following claims by adding the language that is underlined ("__") and by deleting the language that is enclosed within brackets ("[]"):

1. (Fifth Amendment) A method of forming diamond crystals or a diamond film comprising:
 - disposing a substrate in a reaction chamber;
 - introducing, in the absence of a gas stream, a liquid precursor substantially free of water and containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;
 - vaporizing the liquid precursor; and
 - subjecting the vaporized precursor, in the absence of a carrier gas, to a plasma under conditions effective to disassociate the vaporized precursor and promote diamond growth on the substrate in a pressure range from about 20 to 80 Torr.
13. (Fourth Amendment) A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:
 - providing an apparatus including an inlet, a disassociation zone, a deposition zone and an outlet;
 - introducing, in the absence of a gas stream, a liquid precursor substantially free of water and comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the inlet under conditions effective to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;
 - disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and

producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas and in a pressure range from about 20 to 80 Torr.

21. (First Amendment) A method of forming diamond crystals or a diamond film comprising:

disposing a substrate in a reaction chamber in a non-magnetic microwave field plasma system;

introducing a liquid precursor containing methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one into an inlet of the reaction chamber;

vaporizing the liquid precursor;

subjecting the vaporized precursor to a plasma under conditions effective to disassociate the vaporized precursor; and

promoting diamond growth on the substrate, in the absence of a carrier gas, at a pressure in the range from about 20 to 80 Torr.

22. (First Amendment) The method of claim 21, wherein promoting diamond growth includes:

promoting diamond growth[, in the absence of a carrier gas,] at a rate between about 1 [micrometer] and [2.7] 2 micrometers per hour, wherein the pressure is in the range of about 60 to 80 Torr, a substrate temperature is in the range of about 1000°C and 1030°C, and a microwave power is about 2kW.

25. (First Amendment) A plasma enhanced chemical vapor deposition of diamond crystals and diamond films on surfaces of a substrate, comprising:

providing [an] a non-magnetic microwave field plasma apparatus including an inlet, a disassociation zone, a deposition zone and an outlet;

introducing a liquid precursor comprising methanol and at least one carbon and oxygen containing compound having a carbon to oxygen ratio greater than one, into the

inlet under conditions effective to vaporize the liquid precursor, flow the vaporized precursor through the disassociation zone, and through the outlet;

disassociating and reacting the vaporized precursor as vaporized precursor flows or diffuses through the disassociation zone to produce OH, H, O, and carbon containing radicals; and

producing diamond crystals or diamond films on the surface of the substrate in the absence of a carrier gas at a pressure in the range from about 20 to 80 Torr.

26. (First Amendment) The method of claim 25, wherein promoting diamond growth includes:

promoting diamond growth[, in the absence of a carrier gas,] at a rate between about 1 [micrometer] and [2.7] 2 micrometers per hour, wherein the pressure is in the range of about 60 to 80 Torr, a substrate temperature is in the range of about 1000°C and 1030°C, and a microwave power is about 2kW.